PATENT ABSTRACTS OF JAPAN

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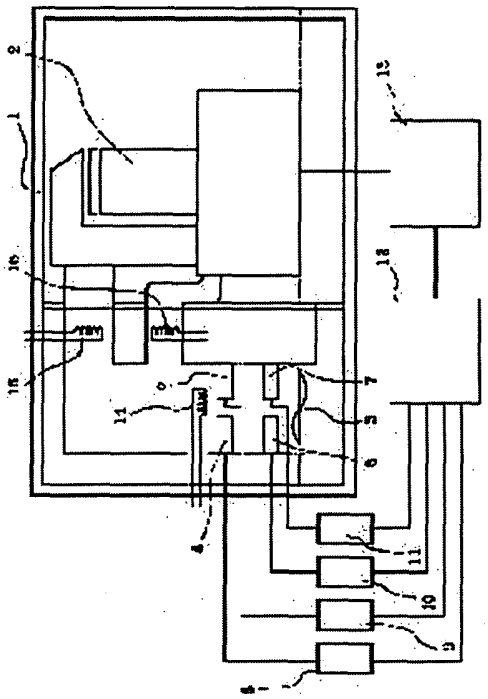
(72)Inventor : NAKAMURA HAJIME

(54) SEMICONDUCTOR MANUFACTURE EQUIPMENT AND MANUFACTURE OF DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To shorten time for temperature adjustment of an aligner, restrain deterioration in the operation rate of equipment, lower vibration generated from temperature adjusting equipment, reduce errors and stoppages of the equipment at performing fine working by the aligner, and increase the operation rate of the equipment, by changing the ability of the temperature adjusting equipment in matching with heat generating state of the aligner and operating the equipment without using wasteful power.
SOLUTION: In semiconductor manufacturing equipment having a chamber 1 provided with an air conditioning means, the air conditioning means has a plurality of compressors 4-7 or a heat exchanger and a means 12 selecting the compressors or the heat exchanger, which are to be operated in accordance with operation of the equipment. There are cases in which this equipment may have means 8-11 which synchronously drive a plurality of the compressors, such that vibration generated from the compressors is reduced by mutual interference.



LEGAL STATUS

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CLAIMS

[Claim(s)]
[Claim 1] They are the semiconductor fabrication machines and equipment which this air-conditioning means has two or more compressors or heat exchangers in semiconductor fabrication machines and equipment with the chamber equipped with the air-conditioning means, and are characterized by this equipment having a means to choose the compressor or heat exchanger worked according to operation of this equipment.
[Claim 2] They are the semiconductor fabrication machines and equipment characterized by for this air-conditioning means having two or more compressors in semiconductor fabrication machines and equipment with the chamber equipped with the air-conditioning means, and having the means which carries out synchronized operation of two or more compressors so that vibration which a compressor generates may be mitigated by the mutual interference.
[Claim 3] Equipment according to claim 2 characterized by carrying out synchronized operation using an inverter.
[Claim 4] For the aforementioned compressor, 3 is [the claim 1 characterized by being the compressor of a refrigerator, or] equipment of a publication either.
[Claim 5] 4 is [a claim 1 or] the device manufacture method characterized by manufacturing a device by the manufacturing process including the process which prepares the equipment of a publication, and the process exposed using this equipment either.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the air conditioner of the thermostat which performs temperature management of semiconductor fabrication machines and equipment.
[0002]
[Description of the Prior Art] If a semiconductor device in recent years is seen, detailed-ization will progress, and in semiconductor manufacture process, the environment in which detailed-ized processing is more possible still also about the semiconductor aligner which manufactures a semiconductor in connection with this micro processing, and semiconductor fabrication machines and equipment is needed. Temperature management severe also about the thermostat which keeps the equipment temperature constant about a semiconductor aligner has been required.
[0003] The thermostat which keeps the equipment temperature constant was conventionally adjusted about the semiconductor aligner to the temperature of which equipment air temperature was lowered with one refrigerator, and this lowered ** tone air was required at the heater etc. Operation of this refrigerator is not concerned with the ON/OFF state of an aligner, does not surely lower the temperature of a certain constant width, and is not concerned with the height of the temperature of equipment, and the working state of equipment, but is performing the temperature control of the same heating value.
[0004] For example, when equipment temperature is [25 degrees and air-conditioning target temperature] 23 degrees in the state of OFF for the power supply of an aligner, a refrigerator lowers the temperature of fixed heating-value (it is considerable grade to temperature gradient of 20 degrees) air-conditioning air, and is carrying out the ** tone of the ** tone air (about five Centigrade) which fell the account of before to 23 degrees correctly at the heater.
[0005] moreover, the case where 40 degrees and air-conditioning target temperature are [equipment temperature] the same with the above, and the power supply of an aligner is 23 degrees in the state of ON -- the above, as well as the equipment OFF state, an equivalent for the temperature gradient of 20 degrees is first cooled with a refrigerator, and the ** tone of the ** tone air which became 20-degree Centigrade is correctly carried out to 23 degrees at the heater
[0006] Thus, excessive power is consumed, in order to make a refrigerator operate, when temperature of the aforementioned equipment may not be lowered, since it was not concerned with the temperature of an aligner, and the working state but fixed temperature is continuously lowered with the refrigerator.
[0007] Moreover, even if it was going to carry out adjustable [of the heating value given to ** tone air with the refrigerator of a piece], it is impossible to change the character up adjustable range of a refrigerator a lot, and the power of simultaneously regularity was used continuously.
[0008]
[Problem(s) to be Solved by the Invention] As mentioned above, there was a problem of a fine temperature control not being made since it had cooled with one refrigerator, but lowering the temperature of constant width first, and performing useless operation of warming further the air cooled

greatly exceeding the target temperature, therefore consuming power vainly, and making equipment operation cost raise conventionally.
[0009] Moreover, equipment temperature was lowered greatly, since operation of raising temperature greatly after that was performed, by the time temperature was stabilized, very long time was taken, when seen in respect of the efficiency on equipment operation, the time of pre-preparation of equipment use was prolonged, and the problem of decline in equipment use efficiency and operation efficiency was also generated.
[0010] The 1st purpose of this invention is working equipment, without changing the capacity of temperature control units, such as a refrigerator or a heater, according to the febrile state of an aligner, and using useless power. The 2nd purpose is shortening the time concerning the ** tone of an aligner and suppressing decline in the operating ratio of equipment.
[0011] Furthermore, the 3rd purpose is reducing vibration which a ** tone facility generates, decreasing an error and an equipment halt when performing micro processing by the aligner, and gathering the operation efficiency of equipment.
[0012]
[Means for Solving the Problem and its Function] In order to solve the above-mentioned problem, it is characterized by for the semiconductor fabrication machines and equipment of this invention having the chamber equipped with the air-conditioning means, for this air-conditioning means having two or more compressors or heat exchangers, and this equipment having a means to choose the compressor or heat exchanger worked according to operation of this equipment. The compressor used by this invention is a compressor of a refrigerator preferably.
[0013] In a desirable mode, it is characterized by for the semiconductor fabrication machines and equipment of this invention having the chamber equipped with the air-conditioning means, and for this air-conditioning means having two or more compressors, and having the means which carries out synchronized operation of two or more compressors so that vibration which a compressor generates may be mitigated by the mutual interference. In this case, it is desirable to carry out synchronized operation using an inverter.
[0014] Moreover, the device manufacture method of this invention is characterized by manufacturing a device by the manufacturing process including the process which prepares the semiconductor fabrication machines and equipment of this invention, and the process exposed using this equipment.
[0015] In another mode, the heater for warming ** tone air, even refrigerators for cooling ** tone air, and each refrigerators are connected, and the semiconductor fabrication machines and equipment of this invention have the inverter which controls a refrigerator, an air-conditioning control section for controlling the synchronized operation of each inverter, and the device control section which measures the heating value which supervises the state of a semiconductor device and equipment has, and is supervised.
[0016] In this composition, the ON/OFF state of equipment and the data of the degree of this temperature of equipment are sent to an air-conditioning control section from the device control section. In an air-conditioning control section, it judges whether two or more how many of the refrigerators of a base should be operated from the sent data and air-conditioning target temperature. A low case is accepted one set of two or more sets of [inner], and when the temperature of a main part is high, the temperature of a main part takes out a control signal to an inverter so that two or more bases may be operated.
[0017] It controls to carry out operation which the vibration of each refrigerator including the synchronizing signal of each refrigerator denies and suits as control to each inverter at this time.
[0018] Thus, by controlling a cooler by the operation situation of the main part of equipment finely, it becomes possible about a cooler to carry out necessary minimum operation, power saving can be realized, the width of face of cooling/heating of a ** tone becomes small, the time concerning a ** tone can be shortened and improvement in shortening of time, such as pre-preparation of equipment, and the operation efficiency of equipment is attained.
[0019] Furthermore, vibration which can be made to carry out synchronized operation of two or more

refrigerators, becomes possible [controlling towards negating vibration of a refrigerator], and has a bad influence on the performance of equipment by in addition controlling a refrigerator and an inverter finely can be mitigated, and it also becomes possible to prevent decline in working efficiency, such as an error of equipment, and a halt.

[0020]

[Example] Hereafter, the example of this invention is explained using drawing.

(The 1st example) Drawing 1 is drawing having shown the semiconductor fabrication machines and equipment which are one example of this invention, and its thermostat. As shown in drawing 1 , these semiconductor fabrication machines and equipment have the thermostat 1 of a wrap outermost shell for the main part 2 of equipment and the aforementioned main part 2 of equipment for burning a semiconductor pattern, and the 1st refrigerator 4 for performing the ** tone in a thermostat, the 2nd refrigerator 5, the 3rd refrigerator 6, and the 4th refrigerator 7 are incorporated in the thermostat 1. Moreover, the 4th inverter 11 is connected [the 3rd inverter 10 and the 4th refrigerator] to each refrigerator to the 1st refrigerator at the 1st inverter 8 and the 2nd refrigerator at the 2nd inverter 9 and the 3rd refrigerator.

[0021] Before each refrigerator, the fan 3 for sending air has clung to the refrigerator, and air is sent to each refrigerator. Moreover, behind each refrigerator, the heater 14, the lens partial heater 15, and the main part relation heater 16 are attached.

[0022] It connects with equipment 2 in the equipment book organization section, and 13 is detecting the ON/OFF state of the aforementioned equipment 2, and temperature of equipment. The ON/OFF state of the equipment detected in the equipment book organization section 13 and the temperature of equipment are changed into an electrical signal, and are inputted into the ** tone control section 12. In the **** control section 12, the data sent from the equipment book organization section 13 and ** tone target temperature are measured, and it judges how many inverters are operated among four inverters.

[0023] Operation of the **** tone control section 12 is concretely explained along with this example. Drawing 2 is operation of a ** tone control section in case the temperature of the main frame is high and the power supply of a main part is in ON state. If the information of [temperature / initial / of equipment] ON state in a main part power supply comes to the ** tone control section 12 by 40 degrees, as shown in drawing 2 , in order that the ** tone control section 12 may operate all the refrigerators 4-7, it will output an actuating signal to all the inverters 8-11, and will operate a refrigerator. When a refrigerator and a heater operate, the temperature of the main frame falls and it becomes the temperature (t0) of a certain convention, the ** tone control section 12 outputs a stop signal to the inverter which is controlling the 3rd and the 4th refrigerator, in order to restrict the operation about four refrigerators which are operating.

[0024] Two sets of inverters, the 1st and the 2nd, perform the ** tone of a thermostat 1 after that. vibration outputted from even refrigerators (the 1st, the 2nd) in order to lessen vibration to which the ** tone control section 12 has a bad influence on the main frame since this state is in the state where of the main frame is working -- the control signal for taking a synchronization so that vibration which carries out [vibration] a denial mutually and is given to equipment 2 may serve as the minimum, and taking the aforementioned synchronization outputs to the 1st and the 2nd inverter

[0025] Drawing 3 is operation of a ** tone control section in case the temperature of the main frame is high and the power supply of a main part is in an OFF state.

[0026] If the information of [in a main part power supply / temperature / initial] an OFF state at 40 degrees comes to the ** tone control section 12, as shown in drawing 3 , in order that the ** tone control section 12 may operate the 1st and the 2nd refrigerator 4 and 5, it will output an actuating signal to the 1st and the 2nd inverter 8 and 9 which are connected to refrigerators 4 and 5, and will operate a refrigerator. The ** tone control section 12 makes a stop signal output to the inverter 9 which is controlling the 2nd refrigerator 5 about the 1st which is operating, and the 2nd refrigerator 4 and 5, when a refrigerator and a heater operate, the temperature of the main frame falls and it becomes the temperature (t0) of a certain convention, in order to restrict the operation.

[0027] The 1st refrigerator 4 and the 1st inverter 8 perform the ** tone of a thermostat 1 after that. Since

this state is in the state which the main frame turns off, control which serves as the minimum about vibration given to the main frame is not carried out, but the control signal for operating one piece or odd refrigerators for power saving is outputted to the 1st inverter.
[0028] Drawing 4 is operation of a ** tone control section in case the temperature of the main frame is low and the power supply of a main part is in ON state.
[0029] If the information of [temperature / initial] ON state in a main part power supply comes to the ** tone control section 12 by about 30 degrees, the ** tone control section 12 will output an actuating signal to all the inverters 8-11 in order to operate all the refrigerators 4-7, as shown in drawing 4 , and will operate a refrigerator. In order that the ** tone control section 12 may restrict the operation about four refrigerators which are operating, they make a stop signal output to the inverter which is controlling the 3rd and the 4th refrigerator, when this organization section 13 and the ** tone control section 12 detect change of this temperature and become the temperature (t0) of a certain convention, if a refrigerator and a heater operate and the temperature of the main frame falls. However, before the absolute temperature of the main frame 2 results in the temperature (t0) of a certain convention in this case for a low reason, ON/OFF of the 3rd and the 4th inverter may be carried out.
[0030] The 1st, the 2nd two refrigerators, and an inverter perform the ** tone of a thermostat 1 after that. in order to lessen vibration to which the ** tone control section 12 has a bad influence on the main frame since this state is in the state where the main frame is working -- the vibration from even refrigerators (the 1st, the 2nd) -- the control signal for taking a synchronization and taking the aforementioned synchronization so that a denial may be carried out mutually and vibration may serve as the minimum is outputted to the 1st and the 2nd inverter
[0031] Drawing 5 is operation of a ** tone control section in case the temperature of the main frame is high and the power supply of a main part is in an OFF state. If the information of [in a main part power supply / temperature / initial] an OFF state at about 30 degrees comes to the ** tone control section 12, as shown in drawing 5 , in order that the ** tone control section 12 may operate the 1st refrigerator 4, it will output an actuating signal to the 1st inverter 8 connected to the 1st refrigerator 4, and will operate a refrigerator. A refrigerator and a heater operate and the 1st inverter 8 performs the ** tone of a thermostat 1 after that.
[0032] Since this state is in the state which the main frame turns off, control which serves as the minimum about vibration given to the main frame is not carried out, but the control signal for operating one refrigerator for power saving is outputted only to the 1st inverter 8.
[0033] As mentioned above, although it is about the case where even number is operated simultaneously, even if it always operates one refrigerator with a small capacity and operates even refrigerators with a big capacity, it is effective in negating vibration.
[0034] (The 2nd example) The example of the device manufacture method of having used the equipment which next gave [above-mentioned] explanation is explained. Drawing 6 shows the flow of manufacture of minute devices (semiconductor chips, such as IC and LSI, a liquid crystal panel, CCD, the thin film magnetic head, micro machine, etc.). The pattern design of a device is performed at Step 1 (circuit design). The mask in which the designed pattern was formed is manufactured at Step 2 (mask manufacture). On the other hand, at Step 3 (wafer manufacture), a wafer is manufactured using material, such as silicon and glass. Step 4 (wafer process) is called last process, and forms an actual circuit on a wafer with lithography technology using the mask and wafer which carried out [above-mentioned] preparation. The following step 5 (assembly) is called back process, is a process semiconductor-chip-ized using the wafer produced by Step 4, and includes processes, such as an assembly process (dicing, bonding) and a packaging process (chip enclosure). At Step 6 (inspection), the check test of the semiconductor device produced at Step 5 of operation, an endurance test, etc. are inspected. Through such a process, a semiconductor device is completed and this is shipped (Step 7).
[0035] Drawing 7 shows the detailed flow of the above-mentioned wafer process (Step 4). The front face of a wafer is oxidized at Step 11 (oxidization). An insulator layer is formed in a wafer front face at Step 12 (CVD). At Step 13 (electrode formation), an electrode is formed by vacuum evaporationo on a wafer. Ion is driven into a wafer at Step 14 (ion implantation). A resist is applied to a wafer at Step 15

(resist processing). At Step 16 (exposure), the circuit pattern of a mask is put in order, baked and exposed to two or more shot fields of a wafer with the equipment of this invention which gave [above-mentioned] explanation. The exposed wafer is developed at Step 17 (development). At Step 18 (etching), portions other than the developed resist image are shaved off. The resist which etching could be managed with Step 19 (resist ablation), and became unnecessary is removed. By carrying out by repeating these steps, a circuit pattern is formed on a wafer multiplex.

[0036] If the process of this example is used, the large-sized device for which manufacture was difficult can be conventionally manufactured to a low cost.

[0037]

[Effect of the Invention] As explained above, by controlling a cooler by the operation situation of the main part of equipment finely according to this invention Become possible about a cooler to carry out necessary minimum operation, and can realize power saving and it becomes reducible [equipment employment cost]. Moreover, the width of face of the ** tone air cooling / heating at the time of a ** tone becomes small, the time concerning a ** tone can be shortened and improvement in shortening of time, such as pre-preparation of equipment, and the operation efficiency of equipment is attained.

[0038] Furthermore, it becomes possible to control towards negating vibration of a refrigerator by controlling a refrigerator and an inverter finely and carrying out synchronized operation of the even refrigerators, in addition, vibration which has a bad influence on the performance of equipment can be mitigated, and it also becomes possible to prevent decline in working efficiency, such as an error halt of equipment.

[Translation done.]

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the air conditioner of the thermostat which performs temperature management of semiconductor fabrication machines and equipment.

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PRIOR ART

[Description of the Prior Art] If a semiconductor device in recent years is seen, detailed-ization will progress, and in semiconductor manufacture process, the environment in which detailed-ized processing is more possible still also about the semiconductor aligner which manufactures a semiconductor in connection with this micro processing, and semiconductor fabrication machines and equipment is needed. Temperature management severe also about the thermostat which keeps the equipment temperature constant about a semiconductor aligner has been required.
[0003] The thermostat which keeps the equipment temperature constant was conventionally adjusted about the semiconductor aligner to the temperature of which equipment air temperature was lowered with one refrigerator, and this lowered ** tone air was required at the heater etc. Operation of this refrigerator is not concerned with the ON/OFF state of an aligner, does not surely lower the temperature of a certain constant width, and is not concerned with the height of the temperature of equipment, and the working state of equipment, but is performing the temperature control of the same heating value.
[0004] For example, when equipment temperature is [25 degrees and air-conditioning target temperature] 23 degrees in the state of OFF for the power supply of an aligner, a refrigerator lowers the temperature of fixed heating-value (it is considerable grade to temperature gradient of 20 degrees) air-conditioning air, and is carrying out the ** tone of the ** tone air (about five Centigrade) which fell the account of before to 23 degrees correctly at the heater.
[0005] moreover, the case where 40 degrees and air-conditioning target temperature are [equipment temperature] the same with the above, and the power supply of an aligner is 23 degrees in the state of ON -- the above, as well as the equipment OFF state, an equivalent for the temperature gradient of 20 degrees is first cooled with a refrigerator, and the ** tone of the ** tone air which became 20-degree Centigrade is correctly carried out to 23 degrees at the heater
[0006] Thus, excessive power is consumed, in order to make a refrigerator operate, when temperature of the aforementioned equipment may not be lowered, since it was not concerned with the temperature of an aligner, and the working state but fixed temperature is continuously lowered with the refrigerator.
[0007] Moreover, even if it was going to carry out adjustable [of the heating value given to ** tone air with the refrigerator of a piece], it is impossible to change the character up adjustable range of a refrigerator a lot, and the power of simultaneously regularity was used continuously.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, by this invention, a cooler is finely controlled by the operation situation of the main part of equipment. Therefore, it becomes possible about a cooler to carry out necessary minimum operation, and power saving can be realized, and it becomes reducible [equipment employment cost], and the width of face of the ** tone air cooling / heating at the time of a ** tone becomes small, the time concerning a ** tone can be shortened and improvement in shortening of time, such as pre-preparation of equipment, and the operation efficiency of equipment is attained.
[0038] Furthermore, it becomes possible to control towards negating vibration of a refrigerator by controlling a refrigerator and an inverter finely and carrying out synchronized operation of the even refrigerators, in addition, vibration which has a bad influence on the performance of equipment can be mitigated, and it also becomes possible to prevent decline in working efficiency, such as an error halt of equipment.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] As mentioned above, there was a problem of a fine temperature control not being made since it had cooled with one refrigerator, but lowering the temperature of constant width first, and performing useless operation of warming further the air cooled greatly exceeding the target temperature, therefore consuming power vainly, and making equipment operation cost raise conventionally.
[0009] Moreover, equipment temperature was lowered greatly, since operation of raising temperature greatly after that was performed, by the time temperature was stabilized, very long time was taken, when seen in respect of the efficiency on equipment operation, the time of pre-preparation of equipment use was prolonged, and the problem of decline in equipment use efficiency and operation efficiency was also generated.
[0010] The 1st purpose of this invention is working equipment, without changing the capacity of temperature control units, such as a refrigerator or a heater, according to the febrile state of an aligner, and using useless power. The 2nd purpose is shortening the time concerning the ** tone of an aligner and suppressing decline in the operating ratio of equipment.
[0011] Furthermore, the 3rd purpose is reducing vibration which a ** tone facility generates, decreasing an error and an equipment halt when performing micro processing by the aligner, and gathering the operation efficiency of equipment.

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OPERATION

[Means for Solving the Problem and its Function] In order to solve the above-mentioned problem, it is characterized by for the semiconductor fabrication machines and equipment of this invention having the chamber equipped with the air-conditioning means, for this air-conditioning means having two or more compressors or heat exchangers, and this equipment having a means to choose the compressor or heat exchanger worked according to operation of this equipment. The compressor used by this invention is a compressor of a refrigerator preferably.
[0013] In a desirable mode, it is characterized by for the semiconductor fabrication machines and equipment of this invention having the chamber equipped with the air-conditioning means, and for this air-conditioning means having two or more compressors, and having the means which carries out synchronized operation of two or more compressors so that vibration which a compressor generates may be mitigated by the mutual interference. In this case, it is desirable to carry out synchronized operation using an inverter.
[0014] Moreover, the device manufacture method of this invention is characterized by manufacturing a device by the manufacturing process including the process which prepares the semiconductor fabrication machines and equipment of this invention, and the process exposed using this equipment.
[0015] In another mode, the heater for warming ** tone air, even refrigerators for cooling ** tone air, and each refrigerators are connected, and the semiconductor fabrication machines and equipment of this invention have the inverter which controls a refrigerator, an air-conditioning control section for controlling the synchronized operation of each inverter, and the device control section which measures the heating value which supervises the state of a semiconductor device and equipment has, and is supervised.
[0016] In this composition, the ON/OFF state of equipment and the data of the degree of this temperature of equipment are sent to an air-conditioning control section from the device control section. In an air-conditioning control section, it judges whether two or more how many of the refrigerators of a base should be operated from the sent data and air-conditioning target temperature. A low case is accepted one set of two or more sets of [inner], and when the temperature of a main part is high, the temperature of a main part takes out a control signal to an inverter so that two or more bases may be operated.
[0017] It controls to carry out operation which the vibration of each refrigerator including the synchronizing signal of each refrigerator denies and suits as control to each inverter at this time.
[0018] Thus, by controlling a cooler by the operation situation of the main part of equipment finely, it becomes possible about a cooler to carry out necessary minimum operation, power saving can be realized, the width of face of cooling/heating of a ** tone becomes small, the time concerning a ** tone can be shortened and improvement in shortening of time, such as pre-preparation of equipment, and the operation efficiency of equipment is attained.
[0019] Furthermore, vibration which can be made to carry out synchronized operation of two or more refrigerators, becomes possible [controlling towards negating vibration of a refrigerator], and has a bad influence on the performance of equipment by in addition controlling a refrigerator and an inverter

finely can be mitigated, and it also becomes possible to prevent decline in working efficiency, such as an error of equipment, and a halt.

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EXAMPLE

[Example] Hereafter, the example of this invention is explained using drawing.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the schematic diagram having shown these whole semiconductor fabrication machines and equipment.
[Drawing 2] It is drawing having shown the equipment temperature pair inverter and the ON/OFF state of a refrigerator.
[Drawing 3] It is drawing having shown the equipment temperature pair inverter and the ON/OFF state of a refrigerator.
[Drawing 4] It is drawing having shown the equipment temperature pair inverter and the ON/OFF state of a refrigerator.
[Drawing 5] It is drawing having shown the equipment temperature pair inverter and the ON/OFF state of a refrigerator.
[Drawing 6] It is the flow chart which shows the device manufacture method that the aligner of this invention can be used.
[Drawing 7] It is the detailed flow chart of the wafer process in drawing 6 .
[Description of Notations]
1: the fan for sending a thermostat, the main part of 2:equipment, and 3:air, and 4: -- the 1st refrigerator and 5: -- the 2nd refrigerator and 6: -- the 3rd refrigerator and 7: -- the 4th refrigerator and 8: -- the 1st inverter and 9: -- the 2nd inverter and 10: -- the 3rd inverter and 11: -- the 4th inverter, 12:** tone control section, and 13:main frame control section

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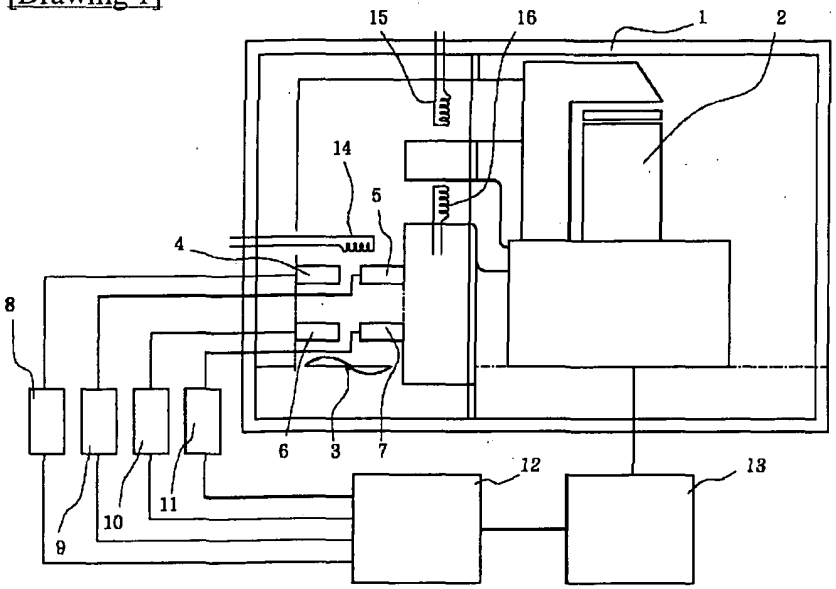
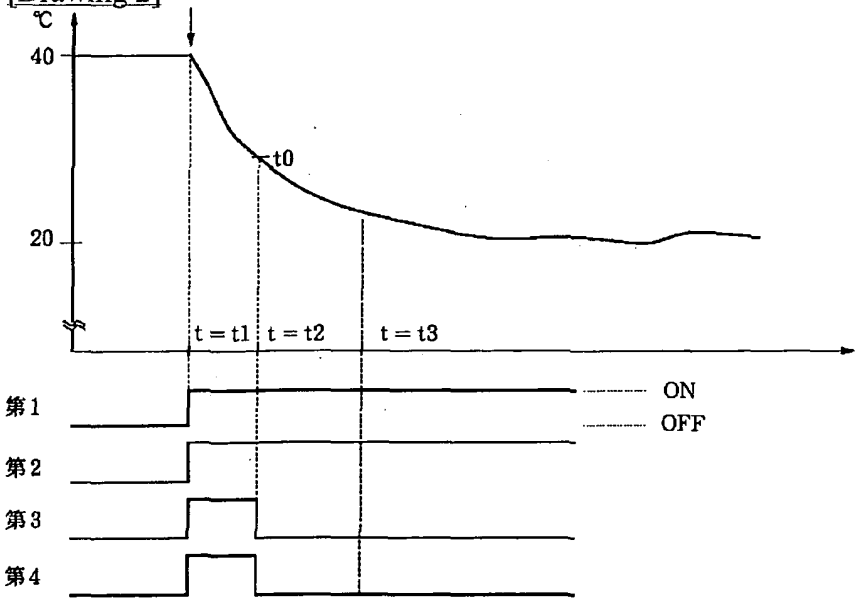
DRAWINGS

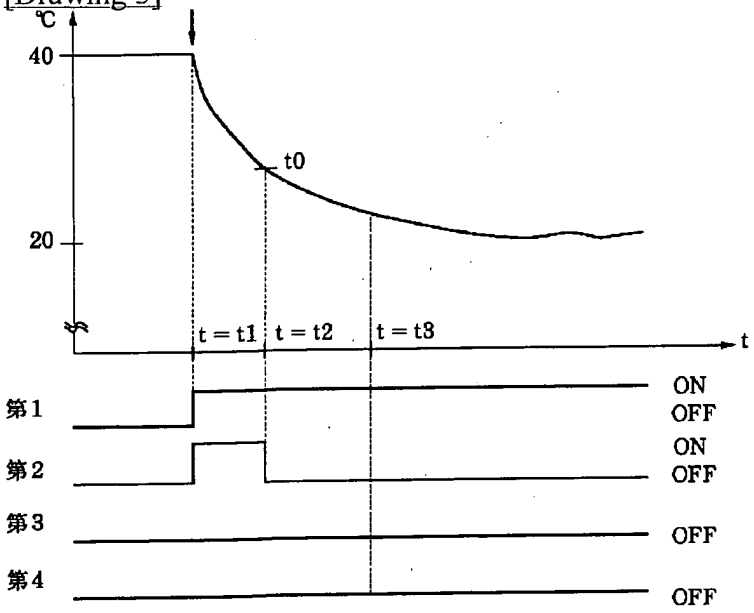
[Drawing 1]



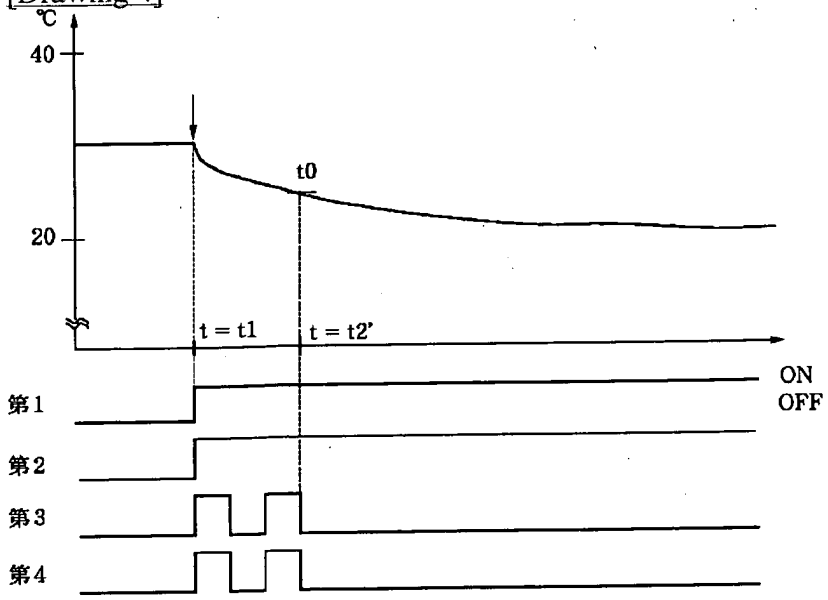
[Drawing 2]



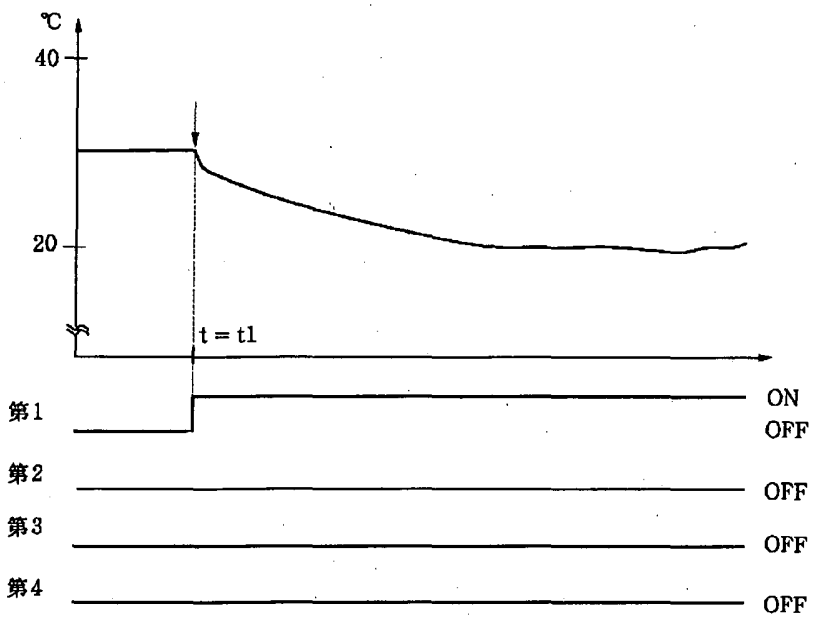
[Drawing 3]



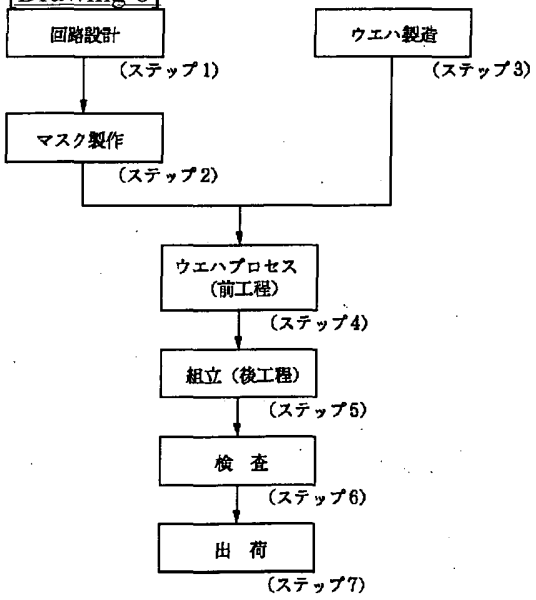
[Drawing 4]



[Drawing 5]

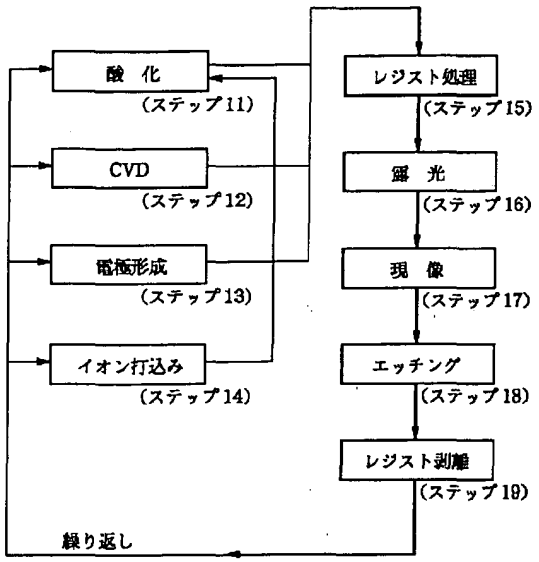


[Drawing 6]



半導体デバイス製造フロー

[Drawing 7]



ウエハプロセス

[Translation done.]

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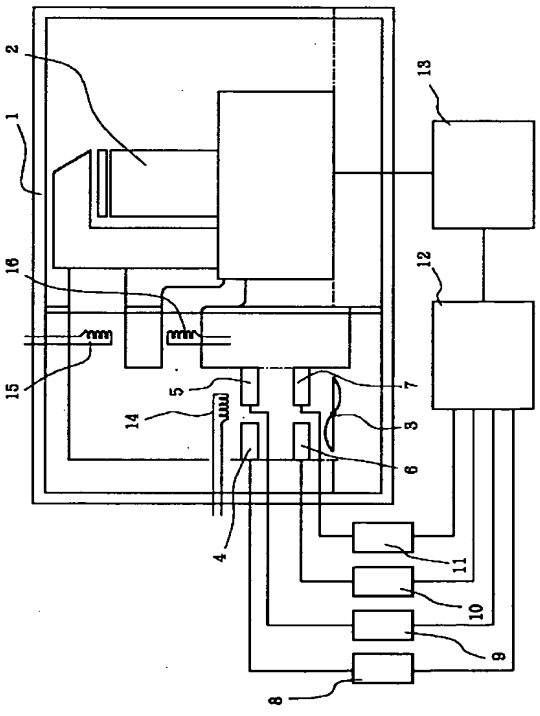
(54)【発明の名称】　半導体製造装置およびデバイス製造方法

(57)【要約】
【課題】　露光装置の発熱状態に合わせて温調設備の能力を切り替え、無駄な電力を使うことなく装置を稼動させることにより、露光装置の温調時間を短縮し、装置の稼働率の低下を抑える。さらに、温調設備の発生する振動を低減させ、露光装置による微細加工を行なう際のエラーや装置停止を減少させ、装置の稼動効率を上げる。
【解決手段】　空調手段を備えたチャンバ（１）を持つ半導体製造装置において、空調手段は複数のコンプレッサ（４～７）または熱交換器を有し、装置の動作に応じて稼動させるコンプレッサまたは熱交換器を選択する手段（１２）を有する製造装置。この装置は、コンプレッサの発生する振動を相互干渉によって軽減するよう複数のコンプレッサを同期運転する手段（８～１１）を有する場合がある。



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【特許請求の範囲】

【請求項１】　空調手段を備えたチャンバを持つ半導体製造装置において、該空調手段は複数のコンプレッサまたは熱交換器を有し、該装置は該装置の動作に応じて稼動させるコンプレッサまたは熱交換器を選択する手段を有することを特徴とする半導体製造装置。

【請求項２】　空調手段を備えたチャンバを持つ半導体製造装置において、該空調手段は複数のコンプレッサを有し、コンプレッサの発生する振動を相互干渉によって軽減するよう複数のコンプレッサを同期運転する手段を有することを特徴とする半導体製造装置。

【請求項３】　インバータを用いて同期運転することを特徴とする請求項２記載の装置。

【請求項４】　前記コンプレッサは冷凍器のコンプレッサであることを特徴とする請求項１乃至３のいずれか記載の装置。

【請求項５】　請求項１ないし４のいずれか記載の装置を用意する工程と、該装置を用いて露光を行なう工程を含む製造工程によってデバイスを製造することを特徴とするデバイス製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、半導体製造装置の温度管理を行なう恒温槽の空調設備に関するものである。

【０００２】

【従来の技術】近年の半導体素子を見ると微細化が進み、半導体製造過程ではこの微細加工に伴い半導体を製造する半導体露光装置、半導体製造装置についてもますます微細化加工可能な環境が必要とされている。半導体露光装置について、その装置温度を一定に保つ恒温槽についても厳しい温度管理が要求されてきている。

【０００３】従来半導体露光装置について、その装置温度を一定に保つ恒温槽は１個の冷凍器で装置空気温度を下げ、この下げた温調空気をヒーター等で要求された温度まで調整していた。この冷凍器の動作は、露光装置のＯＮ／ＯＦＦ状態に関わらず必ずある一定幅の温度を下げるものであり、装置の温度の高低、装置の稼動状態に関わらず同じ熱量の温度調整を行なっている。

【０００４】例えば、露光装置の電源がＯＦＦ状態で装置温度が２５度、空調目標温度が２３度の場合、冷凍器は一定熱量（例えば２０度の温度差に相当程度）空調空気の温度を下げ、前記下がった温調空気（摂氏５度程度）をヒーターで２３度に正確に温調している。

【０００５】また露光装置の電源がＯＮ状態で装置温度が４０度、空調目標温度が前記と同じく２３度の場合、前出装置ＯＦＦ状態と同じく、まず冷凍器で２０度の温度差相当分を冷却し、摂氏２０度になった温調空気をヒーターで２３度に正確に温調している。

【０００６】このように、露光装置の温度、稼動状態に関わらず絶えず冷凍器によって一定の温度を下げているため、前記装置の温度を下げなくてもいい場合においても冷凍器を運転させるために余分な電力を消費している。

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【０００７】また、一個の冷凍器によって温調空気に与える熱量を可変させようとしても、冷凍器の性格上可変範囲を大きく変えることは不可能であり、絶えずほぼ一定の電力を使用していた。

【０００８】

【発明が解決しようとする課題】前述のように、従来は１個の冷凍器で冷却していたため細かな温度調整ができず、まず一定幅の温度を下げ、その目標温度を大きく超えて冷却された空気をさらに暖めるという無駄な動作を行ない、そのため電力を無駄に消費し装置運転コストをアップさせているという問題があった。

【０００９】また、大きく装置温度を下げて、その後大きく温度を上げるという動作を行なっていたため、温度が安定するまでに非常に長い時間がかかり、装置運転上の効率という点で見ると装置使用の前準備の時間が延び、装置使用効率、運転効率の低下という問題も発生していた。

【００１０】本発明の第１の目的は、露光装置の発熱状態に合わせて冷凍器またはヒーター等の温調装置の能力を切り替え、無駄な電力を使うことなく装置を稼動させることである。第２の目的は、露光装置の温調にかかる時間を短縮し、装置の稼働率の低下を抑えることである。

【００１１】更に第３の目的は、温調設備の発生する振動を低減させ、露光装置による微細加工を行なう上でのエラーや装置停止を減少させ、装置の稼動効率を上げることである。

【００１２】

【課題を解決するための手段および作用】上記問題を解決するため、本発明の半導体製造装置は空調手段を備えたチャンバを持ち、該空調手段は複数のコンプレッサまたは熱交換器を有し、該装置は該装置の動作に応じて稼動させるコンプレッサまたは熱交換器を選択する手段を有することを特徴とする。本発明で用いるコンプレッサは、好ましくは冷凍器のコンプレッサである。

【００１３】好ましい態様において、本発明の半導体製造装置は空調手段を備えたチャンバを持ち、該空調手段は複数のコンプレッサを有し、コンプレッサの発生する振動を相互干渉によって軽減するよう複数のコンプレッサを同期運転する手段を有することを特徴とする。この場合、インバータを用いて同期運転することが好ましい。

【００１４】また本発明のデバイス製造方法は、本発明の半導体製造装置を用意する工程と、該装置を用いて露光を行なう工程を含む製造工程によってデバイスを製造することを特徴とする。

【００１５】本発明の半導体製造装置は、別の態様において、温調空気を暖めるためのヒーターと、温調空気を冷却するための偶数個の冷凍器と、各冷凍器が接続され、冷凍器の制御を行なうインバータと、各インバータの同期運転を制御するための空調制御部と、半導体装置の状態を監視し装置が持っているであろう熱量等を測定、監視する装置制御部を持つ。

【００１６】本構成において装置制御部から装置のＯＮ／ＯＦＦ状態、装置の本体温度のデータが空調制御部に送られる。空調制御部において、送られてきたデータと空調目標温度より複数台の冷凍器のうち何台を動作させれば良いかを判断する。本体の温度が低い場合は複数台のうち１台のみ、また本体の温度が高い場合複数台を動作させるようにインバータに制御信号を出す。

【００１７】この時各インバータへの制御として、各冷凍器の同期信号を含め各冷凍器の振動が打ち消しあうような動作をするように制御する。

【００１８】このように、装置本体の稼動状況で冷却機を細かく制御することにより、冷却機を必要最小限の動作をさせることが可能となり省電力が実現でき、温調の冷却／加熱の幅が小さくなり温調にかかる時間が短縮することができ、装置の前準備等の時間の短縮、装置の稼動効率の向上が可能となる。

【００１９】更に加えて冷凍器とインバータを細かく制御することにより、複数個の冷凍器を同期運転させることができ、冷凍器の振動を打ち消す方向で制御することが可能となり装置の性能に悪影響を及ぼす振動を軽減することができ、装置のエラー、停止等の作業効率の低下を防ぐことも可能になる。

【００２０】

【実施例】以下、図を用いて本発明の実施例を説明する。

（第１の実施例）図１は本発明の一実施例である半導体製造装置およびその恒温槽を示した図である。図１に示すように、本半導体製造装置は半導体パターンの焼き付けを行なうための装置本体２と前記装置本体２を覆う最外殻の恒温槽１を持ち、恒温槽１内には、恒温槽内の温調を行なうための第１の冷凍器４、第２の冷凍器５、第３の冷凍器６、第４の冷凍器７が組み込まれている。また各冷凍器には第１の冷凍器には第１のインバータ８、第２の冷凍器には第２のインバータ９、第３の冷凍器には第３のインバータ１０、第４の冷凍器には第４のインバータ１１が接続されている。

【００２１】各冷凍器の手前には冷凍器に空気を送るためのファン３が取り付いており、各冷凍器に空気を送っている。また各冷凍器の後ろにはヒーター１４、レンズ部分ヒーター１５、本体関係ヒーター１６が取り付けてある。

【００２２】１３は装置本体制御部で装置２に接続され、前記装置２のＯＮ／ＯＦＦ状態、装置の温度の検知を行なっている。装置本体制御部１３で検知された装置のＯＮ／ＯＦＦ状態、装置の温度は、電気信号に変換され温調制御部１２へ入力される。温調制御部１２では、装置本体制御部１３から送られてきたデータと温調目標温度とを比較し、４個あるインバータのうち何個のインバータを動作させるかを判断する。

【００２３】本温調制御部１２の動作を本実施例に沿って具体的に説明する。図２は本体装置の温度が高く且つ本体の電源がＯＮ状態のときの温調制御部の動作である。装置初期温度が４０度で本体電源がＯＮ状態という情報が温調制御部１２にくると、温調制御部１２は図２に示すようにすべての冷凍器４～７を動作させるためすべてのインバータ８～１１に動作信号を出力し冷凍器を動作させる。冷凍器とヒーターが動作し本体装置の温度が下がりある規定の温度（ｔ０）になった場合、温調制御部１２は動作している４台の冷凍器についてその動作を制限するために、第３、第４の冷凍器を制御しているインバータに停止信号を出力する。

【００２４】その後第１、第２の２台のインバータにより恒温槽１の温調を行なう。この状態は本体装置が稼動している状態にあるため、温調制御部１２は本体装置に悪影響を与える振動を少なくするため、偶数個（第１、第２）の冷凍器から出力される振動がお互い打ち消し合い装置２に与える振動が最小となるように同期を取り、前記同期を取るための制御信号を第１、第２のインバータに出力する。

【００２５】図３は本体装置の温度が高く且つ本体の電源がＯＦＦ状態のときの温調制御部の動作である。

【００２６】初期温度が４０度で本体電源がＯＦＦ状態という情報が温調制御部１２にくると、温調制御部１２は図３に示すように第１、第２の冷凍器４、５を動作させるために、冷凍器４，５に接続されている第１、第２インバータ８、９に動作信号を出力し冷凍器を動作させる。冷凍器とヒーターが動作し本体装置の温度が下がりある規定の温度（ｔ０）になった場合、温調制御部１２は動作している第１、第２の冷凍器４，５について、その動作を制限するために第２の冷凍器５を制御しているインバータ９に停止信号を出力させる。

【００２７】その後第１の冷凍器４、第１のインバータ８により恒温槽１の温調を行なう。この状態は本体装置がＯＦＦしている状態であるため、本体装置に与える振動について最小となるような制御はせず、省電力のため１個、または奇数個の冷凍器を動作させているための制御信号を第１のインバータに出力する。

【００２８】図４は本体装置の温度が低く且つ本体の電源がＯＮ状態のときの温調制御部の動作である。

【００２９】初期温度が３０度程度で本体電源がＯＮ状態という情報が温調制御部１２にくると、温調制御部１２は図４に示すようにすべての冷凍器４～７を動作させるためすべてのインバータ８～１１に動作信号を出力

し、冷凍器を動作させる。冷凍器とヒーターが動作し本体装置の温度が下がると、本体制御部１３、温調制御部１２は本温度の変化を検知しある規定の温度（ｔ０）になった場合、温調制御部１２は動作している４台の冷凍器について、その動作を制限するために第３、第４の冷凍器を制御しているインバータに停止信号を出力させる。但しこの場合、本体装置２の絶対温度が低いため、ある規定の温度（ｔ０）に至る前に第３、第４のインバータをＯＮ／ＯＦＦすることもある。

【００３０】その後第１、第２の２台の冷凍器、インバータにより恒温槽１の温調を行なう。この状態は本体装置が稼動している状態であるため、温調制御部１２は本体装置に悪影響を与える振動を少なくするため、偶数個（第１、第２）の冷凍器からの振動がお互い打ち消し合い振動が最小となるように同期を取り前記同期を取るための制御信号を、第１、第２のインバータに出力する。

【００３１】図５は本体装置の温度が高く且つ本体の電源がＯＦＦ状態のときの温調制御部の動作である。初期温度が３０度程度で本体電源がＯＦＦ状態という情報が温調制御部１２にくると、温調制御部１２は図５に示すように第１の冷凍器４を動作させるために、第１の冷凍器４に接続されている第１のインバータ８に動作信号を出力し冷凍器を動作させる。冷凍器とヒーターが動作しその後、第１のインバータ８により恒温槽１の温調を行なう。

【００３２】この状態は本体装置がＯＦＦしている状態であるため、本体装置に与える振動について最小となるような制御はせず、省電力のため１個の冷凍器を動作させているための制御信号を第１のインバータ８にのみ出力する。

【００３３】以上、偶数を同時に動作させた場合についてであるが、容量の小さな冷凍器を常時１台動作させ、容量の大きな冷凍器を偶数台動作させても振動を打ち消す効果はある。

【００３４】（第２の実施例）次に上記説明した装置を利用したデバイス製造方法の実施例を説明する。図６は微小デバイス（ＩＣやＬＳＩ等の半導体チップ、液晶パネル、ＣＣＤ、薄膜磁気ヘッド、マイクロマシン等）の製造のフローを示す。ステップ１（回路設計）ではデバイスのパターン設計を行なう。ステップ２（マスク製作）では設計したパターンを形成したマスクを製作する。一方、ステップ３（ウェハ製造）ではシリコンやガラス等の材料を用いてウェハを製造する。ステップ４（ウェハプロセス）は前工程と呼ばれ、上記用意したマスクとウェハを用いて、リソグラフィ技術によってウェハ上に実際の回路を形成する。次のステップ５（組立て）は後工程と呼ばれ、ステップ４によって作製されたウェハを用いて半導体チップ化する工程であり、アッセンブリ工程（ダイシング、ボンディング）、パッケージング工程（チップ封入）等の工程を含む。ステップ６

（検査）ではステップ５で作製された半導体デバイスの動作確認テスト、耐久性テスト等の検査を行なう。こうした工程を経て、半導体デバイスが完成し、これが出荷（ステップ７）される。

【００３５】図７は上記ウェハプロセス（ステップ４）の詳細なフローを示す。ステップ１１（酸化）ではウェハの表面を酸化させる。ステップ１２（ＣＶＤ）ではウェハ表面に絶縁膜を形成する。ステップ１３（電極形成）ではウェハ上に電極を蒸着によって形成する。ステップ１４（イオン打込み）ではウェハにイオンを打ち込む。ステップ１５（レジスト処理）ではウェハにレジストを塗布する。ステップ１６（露光）では上記説明した本発明の装置によってマスクの回路パターンをウェハの複数のショット領域に並べて焼付け露光する。ステップ１７（現像）では露光したウェハを現像する。ステップ１８（エッチング）では現像したレジスト像以外の部分を削り取る。ステップ１９（レジスト剥離）ではエッチングが済んで不要となったレジストを取り除く。これらのステップを繰り返し行なうことによって、ウェハ上に多重に回路パターンが形成される。

【００３６】本実施例の生産方法を用いれば、従来は製造が難しかった大型のデバイスを低コストに製造することができる。

【００３７】

【発明の効果】以上説明したように、本発明によれば装置本体の稼動状況で冷却機を細かく制御することにより、冷却機を必要最小限の動作をさせることが可能となり、省電力が実現でき装置運用コストの削減が可能となり、また温調時の温調空気の冷却／加熱の幅が小さくなり温調にかかる時間が短縮することができ、装置の前準備等の時間の短縮、装置の稼動効率の向上が可能となる。

【００３８】更に加えて、冷凍器とインバータを細かく制御し偶数個の冷凍器を同期運転させることにより、冷凍器の振動を打ち消す方向で制御することが可能となり、装置の性能に悪影響を及ぼす振動を軽減することができ、装置のエラー停止等の作業効率の低下を防ぐことも可能になる。

【図面の簡単な説明】

【図１】　本半導体製造装置の全体を示した概要図である。

【図２】　装置温度対インバータ、冷凍器のＯＮ／ＯＦＦ状態を示した図である。

【図３】　装置温度対インバータ、冷凍器のＯＮ／ＯＦＦ状態を示した図である。

【図４】　装置温度対インバータ、冷凍器のＯＮ／ＯＦＦ状態を示した図である。

【図５】　装置温度対インバータ、冷凍器のＯＮ／ＯＦＦ状態を示した図である。

【図６】　本発明の露光装置を利用できるデバイス製造

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方法を示すフローチャートである。

【図７】　図６中のウェハプロセスの詳細なフローチャートである。

【符号の説明】

１：恒温槽、２：装置本体、３：空気を送るためのファン、４：第１の冷凍器、５：第２の冷凍器、６：第３の冷凍器、７：第４の冷凍器、８：第１のインバータ、９：第２のインバータ、１０：第３のインバータ、１１：第４のインバータ、１２：温調制御部、１３：本体装置制御部。

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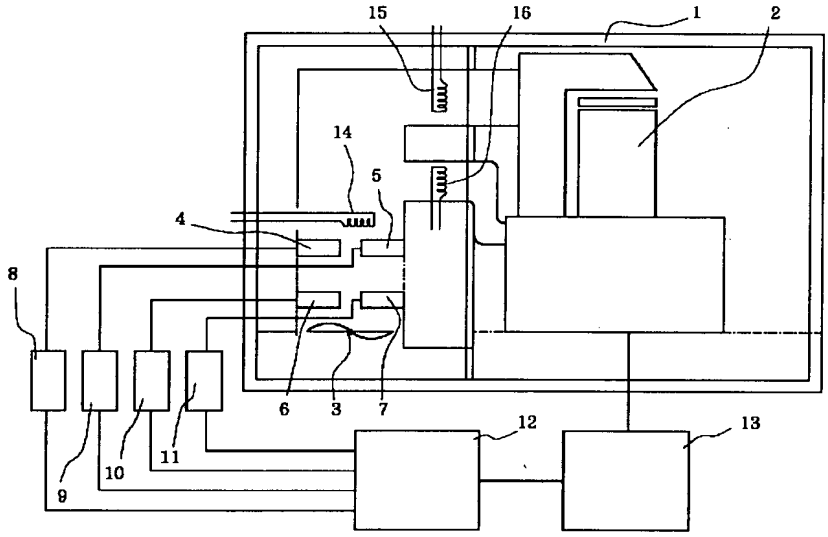
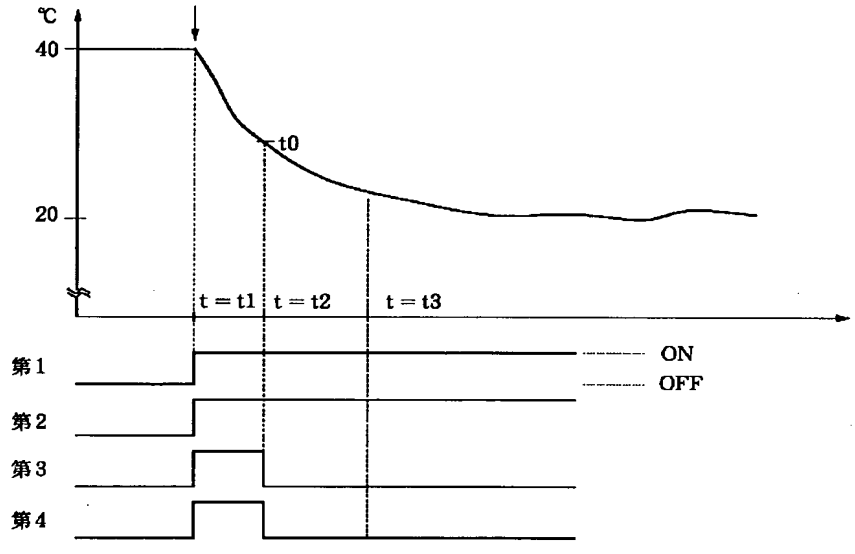
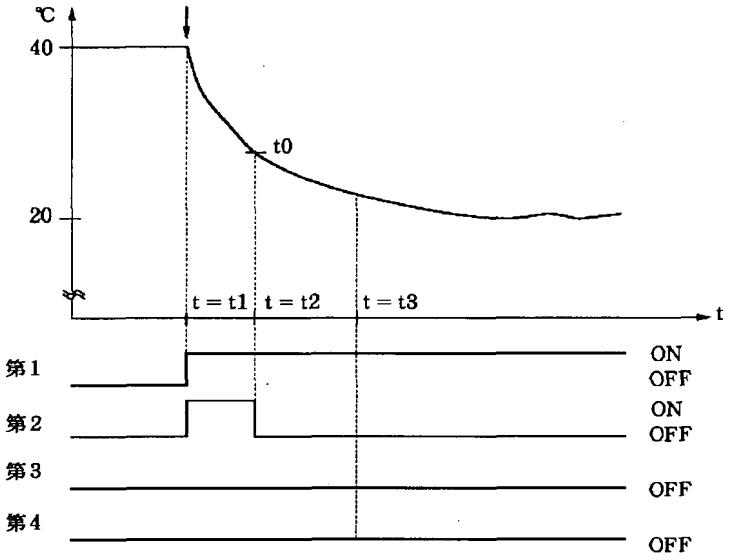
【図１】



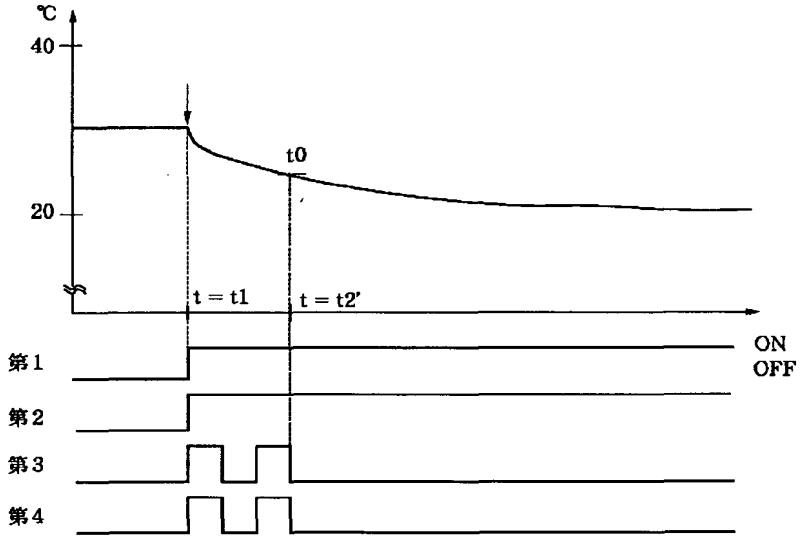
【図２】



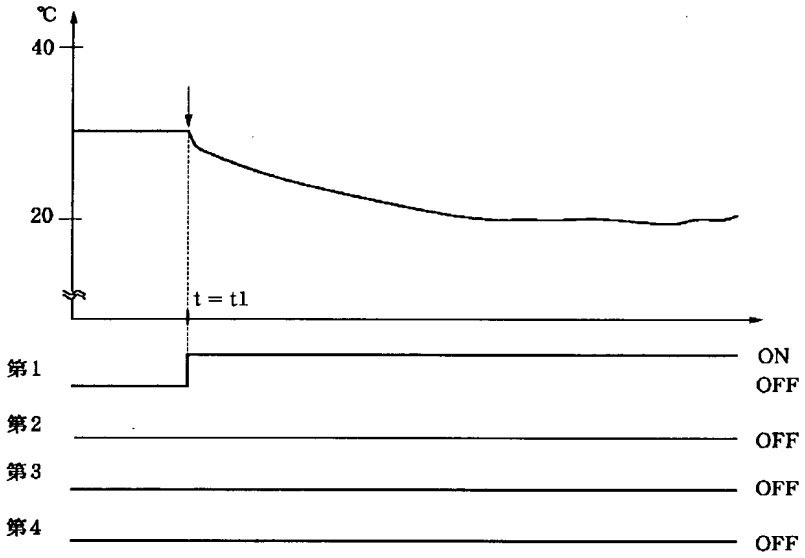
【図３】


℃
40
20
t0
t = t1
t = t2
t = t3
t
第1
第2
第3
第4
ON
OFF
ON
OFF
OFF
OFF

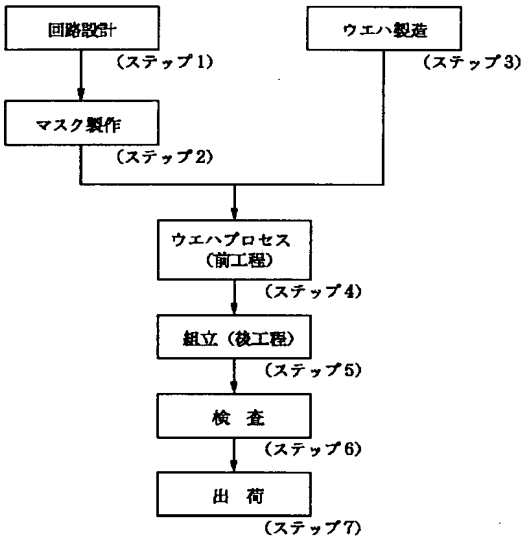
【図４】


℃
40
20
t0
t = t1
t = t2'
第1
第2
第3
第4
ON
OFF

【図５】

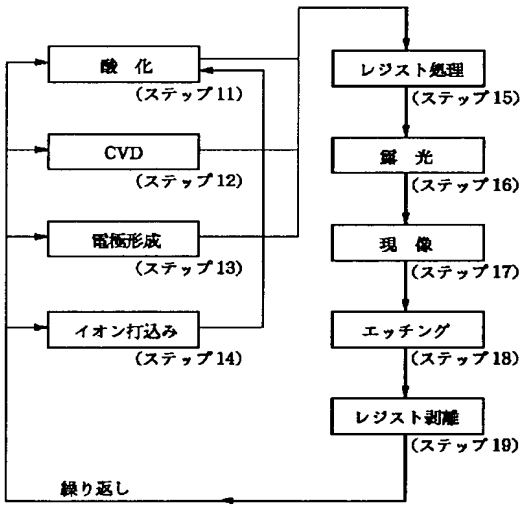


【図６】



半導体デバイス製造フロー

【図７】



ウエハプロセス